

EFFECTS OF NO_x EMISSIONS FROM THE
PROPOSED INTERMOUNTAIN POWER PROJECT ON
DEPOSITION AND SURFACE WATER ACIDIFICATION
IN THE WASATCH AND UINTA MOUNTAINS

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1. INTRODUCTION

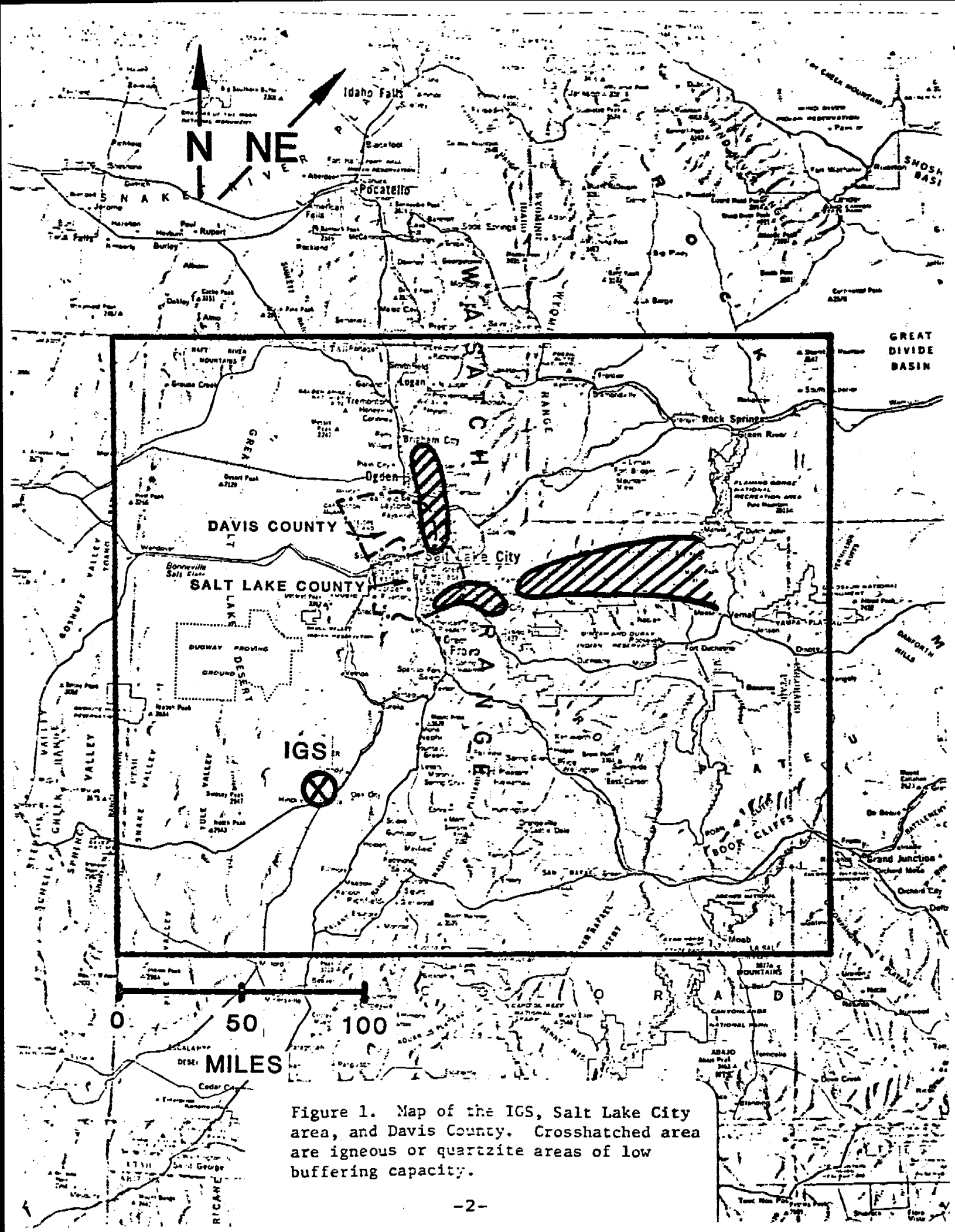
Conservationist groups have recently questioned the level of nitrogen oxide (NO_x) emission control proposed for the Intermountain Generating Station (IGS).¹ This power plant has been designed to incorporate an NO_x control system that will meet an emission limit of 0.55 pounds per million BTU. The groups claim that a more stringent standard must be set in order to prevent an increase in the acidity of precipitation and surface waters in the distant Wasatch and Uinta Mountains (including both transient acidification of surface waters associated with the spring snowmelt and long-term depletion of lake water buffering capacity). Figure 1 shows the relative locations of the IGS and the Wasatch and Uinta Mountains.

Our comments address this issue by considering the available evidence relating to the physical and chemical processes that govern the extent to which the IGS emissions will potentially impact the mountainous receptor areas of concern. The question of NO_x deposition and surface water acidification is discussed in the next section.

2. POTENTIAL CONTRIBUTIONS OF THE IGS TO NO_x AND ACID DEPOSITION.

The following subsections evaluate the level of IGS NO_x and acid deposition impacts in the Wasatch and Uinta Mountains. They conclude that IGS impacts in those areas will be insignificant for several reasons. They also summarize relevant scientific studies on the general lack of evidence of acidity effects in the Wasatch and Uinta Mountains.

¹For example, Alan Miller 1983. Intermountain Power Project: Ozone and Acid Rain, Uinta News (Utah Chapter, Sierra Club).



2.1 Dilution of IGS Emissions During Transport

Perspective on the issues relating to the IGS NO_x emissions can be gained by considering the map in Figure 1. The location of the IGS is shown relative to Salt Lake City and the Wasatch Mountains. Lake and watershed areas potentially susceptible to deposition of acidifying substances in the Wasatch and Uinta Mountain ranges are also indicated. These areas have been identified from water alkalinity data, combined with soil and bedrock geology, assuming surface igneous and quartzite rock structure to be an index of low buffering capacity.² The locations on the map shows the large distances between the IGS and the receptor areas of concern are one hundred miles or more. Thus, the air containing NO_x emissions from the IGS must travel one hundred miles before becoming involved in atmospheric scavenging processes that produce wet deposition at the ground in the sensitive mountain areas. Note that the parts of the Wasatch Range nearest to the plant site are not considered susceptible by the criteria used. It should also be noted that the cropland and scrubbrush land between the IGS and the mountains are not susceptible to atmospheric deposition by the criteria used.

The NO_x impacts of potential concern are of two types, corresponding to two temporal scales. The first concerns winter seasonal conditions, where nitric acid derived from oxidation of NO_2 ³ will be scavenged and deposited in the snowpack. The second involves exposure of low alkalinity surface waters to deposition of acidifying species over many years.

²These criteria are conventionally used, as described, for example, by the USEPA. Water quality data were obtained from the Utah Division of Wildlife Resources and the Dept. of Environmental Health. Data for soils and bedrock geology were obtained from the U.S. Geological Survey.

³For this Assessment, the NO and NO_2 mixture emitted by the IGS is assumed to be converted immediately to NO_2 in the air.

We note that little information is available about baseline ambient air concentrations of NO_2 in Utah. A nonurban level considered typical of the IGS site area is about 4 to 6 ug/m^3 . Maximum values in urban areas of the State range from 38 ug/m^3 to 60 ug/m^3 .⁴ Calculations indicate that the maximum annual average ground-level concentration of NO_2 due to the IGS would be 4.3 ug/m^3 , 7 km from the plant.⁵

Atmospheric dilution would reduce the impact of IGS NO_x emissions substantially by the time they could be transported to the sensitive areas of the Wasatch Range some 160 km (100 miles) away. Assuming uniform vertical mixing and an average (neutral) stability condition, we estimate conservatively that the dilution in IGS emissions over this travel distance would be such that the annual or seasonal average contribution to the ambient NO_2 levels could be no more than about 6 percent of the maximum values near the plant site, i.e., about 0.3 ug/m^3 . An 0.3 ug/m^3 contribution is less than 0.8 percent of the maximum annual ambient NO_2 levels in the sensitive areas of the Wasatch Range. As noted in the following section, terrain channeling of winds near the surface would normally preclude transport of IGS emissions into the high mountains of the Wasatch Range. Thus, even the insignificant estimate of 0.3 ug/m^3 increase is probably an overstatement of potential average IGS impacts in this area.

2.2 Transport of Pollutants From the IGS to Sensitive Areas

An important factor in evaluating the potential for significant impacts of a source to conditions at a receptor is

⁴Bowers, J.F. Personal communication.

⁵Bowers, J.F., A.J. Anderson and W. R. Hargraves 1983. Calculated Air Quality Impact of Emissions from the Intermountain Generating Station -- Two Unit Configuration. Report TR-83-478-01. H.E. Cramer Co., Inc. Salt Lake City, UT.

the frequency with which the source's emissions may be transported toward the receptor by the winds. Several factors significantly limit the likelihood of transport from the IGS toward the potentially susceptible high elevation lakes in the Wasatch and Uinta Mountains.

The surface waters in Utah that exhibit low alkalinities, i.e., low acid-buffering capacity, are generally at elevations of 10,000 feet or more. Vertical mixing in the atmosphere over the Salt Lake Valley is normally restricted in winter to the lowest 3,000 feet by the presence of elevated inversions. The capping effect of the inversions effectively suppresses air motions that would cause pollutants in the valley to be carried into the high mountain areas to the east. Instead, the winds tend to flow from the south to southwest, i.e., parallel to the high terrain, although secondary upslope and downslope flow complicate the prevailing motions near the mountains. Thus, pollutants emitted by the IGS are transported mainly northward and parallel to the Wasatch Range, not eastward into the mountains. The extent to which polluted air from the source regions in the valley penetrates eastward into the areas considered susceptible to acidic deposition is unknown. However, circumstantial evidence that eastward transport is suppressed is found in Utah snowpack chemistry data. Messer et al.⁶ found that chloride concentrations in snow were largely the result of atmospheric scavenging around the Salt Lake area. The water of Great Salt Lake has a substantial salt (NaCl) component. The data of Messer et al.⁶ show that the chloride ion concentration in the snowpack decreases by a factor of two within an eastward distance of 30 miles from Salt Lake City. This strong change eastward into the mountains suggests that the rate of pollutant depositions

⁶Messer, J., L. Slezak and C. Liff 1982. Potential for Acid Snowmelt in the Wasatch Mountains. Report UWRL/Q-82/06 Utah Water Research Laboratory, Utah State University, Logan, UT.

decreases rapidly as storms pass over the valley eastward into the mountains. The data is also consistent with the conclusion that the principal route of air transport in the valley parallels the mountains, and does not penetrate into areas to the east.

Nitrate ion data in the Wasatch Mountain snowpack does not show strong gradients like chloride. The reason for this difference is not known, but may be related to differences in cloud or precipitation scavenging of partially soluble NO_x gases vs scavenging of highly soluble NaCl particles. In any case, the concentrations of nitrate found in the snowpack east of Salt Lake City are 9.3 ueq/liter or less, as compared with larger precipitation values of 10 to 33 ueq/liter further east in

Colorado.⁷ This difference is important because it indicates the minimal influence of the Salt Lake City metropolitan area on deposition in the neighboring area. If the local Salt Lake City influence is small, then one would certainly not expect the IGS, 100 miles away, to have any appreciable effect in the sensitive mountain areas.

2.3 Lack of Evidence of Acidity Effects

The watersheds and biome of the Wasatch Mountains have been potentially exposed to elevated NO_x concentrations from the Salt Lake City and Provo metropolitan areas for many years. These exposures are much larger than the small incremental increase expected from the IGS plume. Is there any evidence of surface water acidification or of adverse effects from nitrate deposition in the mountains? Without exception the answer to this question is no.

⁷Based on 1979-1980 observations from the Nation Acid Deposition Program (NADP) for sites in the Rocky Mountains of Colorado.

The work of Messer et al.⁶ indicates that there is an abundance of alkalinity retained in the Wasatch snowpack and a lack of mineral acidity, both resulting from scavenged soil dust in the snow. This result essentially supercedes the result found in snow chemistry data for sites in the Wasatch Mountains 23

years earlier based on a very limited number of samples for Utah Mountain sites in 1959.⁸ Two Wasatch Mountain samples showed (nitrite and nitrate) levels in snow to be between 1.7 and 11 ueq/liter. These are comparable to values reported by Messer et al.⁶ for snow sampled in 1982.

Water quality data are available from historical lake surveys in the Uinta River, Provo River, Duchesne and Weber River watersheds from 1956 to 1981. Although the lakes sampled by the various surveys are rarely the same, the reported chemical properties show lake alkalinities in the mountains are generally 20 mg/liter as bicarbonate less. The pH value of these lakes range between 6.4 and 8.5 over this same time period.⁹

Data reported for six lakes surveyed in the Uinta Mountains showed nitrate levels of 0.05-0.10 mg/liter with pH 6.5-7.0 in 1956. A survey 23-25 years later of (different) Uinta Mountains lakes (1979-1981) showed nitrate levels from <0.05 to 0.2

⁸Feth, J., S. Rogers, and C. Roberson 1964. Chemical Composition of Snow in the Northern Sierra Nevada and Other Areas. Water Supply Paper 1535-J. U.S. Geological Survey, U.S. Gov't Printing Office, Washington, DC.

⁹Reports of the Utah Div. of Wildlife Resources for the Lake Fork and Uinta River drainages (1971); Hales, D.C.D, 1958. An Inventory of the Waters of the High Uintas; Utah Dept. of Health 1982. State of Utah Clean Lakes Inventory and Classification. Utah Dept. of Health 1980. State Water Quality of Selected Impoundments.

mg/liter and field pH values between 5.8 and 8.2. One case, Pyramid Lake in 1981, was reported to have nitrate levels of 0.6 mg/liter and a pH value of 7.8. This comparison indicates no evidence of any historical change, either in pH or nitrate levels, in high altitude lakes of the Uinta Mountains.

Unfortunately, no parallel information on historical trends appears to be available for the Wasatch Mountain waters. In the absence of such data, the Uinta history must be taken as a regional index of water quality.

As a final comment, it is noted that fish surveys have been conducted in the Uinta and Lake Fork River drainages. The surveys have been made by the Utah Division of Wildlife Resources since 1960. The surveys show no reports of fish population declines attributed to any water quality factor, including acidity.

2.4 Innocuous Nature of Nitrate Deposition

The effects of small incremental increases in nitrate deposition on the biome will be negligible because of its innocuous character. Nitrate is widely used as a fertilizer for enhancement of nitrogen-lean biosystems. It is rapidly assimilated into the biome as part of the growth and decay cycle. There is no evidence that nitrate per se acts in any way other than as a nutrient in terrestrial systems.

Nitrate is not retained in low-alkalinity mountain lakes or streams, because these waters are oligotrophic in character, and the biome is nutrient-lean. Added nitrate is taken up by both aquatic and terrestrial biota as a nutrient. Thus, we would not expect to see accumulation of nitrate in the low alkalinity lakes.

Nitrate deposition may also involve deposition of hydrogen ion. Some researchers have stated that increased acidity of

snowpack results from nitric acid accumulation. As noted above, no reports of fish kills involving acidification with snowmelt have been reported in the West. There is no precedent to expect that any small, incremental change in the deposition of nitrate (as an acid) on snow will cause damage to fisheries in the high altitude waters of the Wasatch Range.

3. SUMMARY OF CONCLUSIONS

A survey of available information indicates that the combination of atmospheric dilution, terrain channeling of transport winds, and suppression of vertical mixing above the surface layer strongly reduces the possibility for any influence of NO_x emissions from the proposed IGS on acid deposition in the neighboring, susceptible areas of the Wasatch Mountains.

The projected increase in annual ambient NO_2 concentrations due to IGS emissions are small (less than 0.8 percent) compared with current baseline urban levels measured in the State. No evidence exists in snowpack, precipitation or water quality data that suggests historical changes have occurred in acidity or in nitrate concentrations since the mid-1950s. This is despite the pressure of a growing metropolitan area around Salt Lake City and Provo, which has involved increased NO_x emissions from stationary and mobile sources since the 1950's.